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ABSTRACT

Three experiments assessed the ability of children 2 to 5 years of age to infer, under very simple task conditions, what another person sees when viewing something from a position other than the children's own. Data indicates that some ability of this genre appears to exist by age 2. The data also suggests a distinction between an earlier and a later developmental form of visual percept inference. (Author/SET)

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The Early Development of Inferences About the Visual Percepts of Others

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Abstract

Three experiments assessed the ability of 2-5 year old children to infer, under very simple task conditions, what another person sees when viewing something from a position other than the children's own. Some ability of this genre appears to exist by 2 years of age, at least. The data suggest a distinction between an earlier (Level 1) and a later (Level 2) developmental form of visual percept inference. At Level 1, S is capable of nonegocentrically inferring that O sees an object presently nonvisible to S himself. At level 2, S is also capable of nonegocentrically inferring how an object that both currently see appears to O, i.e., how it looks from his particular spatial perspective.

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The most commonly used measure of the ability to infer another person's visual experiences has been Piaget's famous "three mountains" task (Piaget & Inhelder, 1956, Ch. 8), in which the S must identify or reproduce another's (O's) view of an array of three toy mountains as he sees it from various perspectives other than S's own. Research using this and similar "perceptual role taking" tasks (Flavell, Botkin, Fry, Wright, & Jarvis, 1968) has generally supported the conclusion that the ability to make accurate, nonegocentric predictions of O's visual percepts is not well developed prior to late middle childhood or early adolescence (e.g., Flavell, 1973; Flavell, et al., 1968, Pp. 55-70; Laurendeau & Pinard, 1970, Ch. 14-16; Piaget & Inhelder, 1956, Ch. 8). A few developmental studies, however, have utilized simpler-looking tasks of the same general type, e.g., using a single, meaningful object with readily nameable sides, such as a doll or toy animal, in place of the usual three-mountain array (Fishbein, Lewis, & Keiffer, 1972; Flavell et al., 1968, Ch. 5; Laubengayer, 1965; Lewis & Fishbein, 1969; Marvin, 1971; Shantz & Watson, 1970; see also Flavell, 1973). These studies have in all cases found at least some competence for visual percept inference at the nursery school and kindergarten levels.

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Experiment 1 represents an extension of these efforts to probe the early beginnings of such competence by further simplifying task requirements. Accordingly, the Ss tested were 2-3.5 year old children and the two tasks used (Picture and Eye Position) had the following

characteristics: (1) they appeared to have at least reasonable face validity as measures of elementary but genuine forms of percept inference ability; (2) they were the simplest, least demanding, easiest looking tests of these elementary forms we could envisage at the time.

Experiment 1

Method

Subjects

The Ss were 16 2 year olds (mean = 2-6 years, range = 2-1 -- 2-11 years) and 9 3 year olds (mean = 3-4 years, range = 3-0 -- 3-7 years), with roughly equal numbers of boys and girls at each age level; 7 additional Ss were invited to participate but proved either unwilling or unable to complete one or both tasks. The older Ss were obtained from a nursery school and the younger ones from a variety of sources (e.g., a Sunday service baby sitting facility located in a church); although no systematic data on SES background were obtained, most of the Ss were probably of middle class origin.

Task Materials and Procedures

Picture task. -- This task contained 6 subtasks which were always administered in the order enumerated below. A description of subtask 1 will illustrate the basic testing procedure. The child was given a piece of 8 X 10-inch opaque white cardboard with a cut-out picture of a dog pasted on one side and a cat on the other, and was first asked to name the object displayed on each side. He next held the cardboard vertically between himself and E, so that he viewed the dog and E the cat, and E asked, first, "What do you see?", and then, "What do I see?" The displays for the remaining subtasks (with the first-mentioned object of each pair representing what S saw on his side) were as follows: subtask 2 (apple-apple) -- a cut-out of an apple, colored in on both

sides, was affixed to an 8 X 10-inch piece of transparent plexiglass with the result that both S and E had identical visual inputs (i.e., both saw the apple); subtask 3 (apple-nothing) -- a cut-out of an apple was affixed to one side of an 8 X 10-inch cardboard, so that nothing was displayed on E's side; subtask 4 (duck-duck) -- like subtask 2, except that the plexiglass frame (5 X 5-inch in this instance) was itself mounted in the hollowed-out center of an 8 X 10-inch cardboard; subtask 5 (bird-nothing) -- essentially the opposite of subtask 4, in that a bird was pasted on S's side of the 5 X 5-inch cardboard center section of an 8 X 10-inch piece of plexiglass; subtask 6 (cat-dog) -- the same card as in subtask 1, except with the S and E views reversed. Note that subtasks 2 and 4 could be correctly answered on a non-inferential, purely egocentric basis, since S and O had identical visual inputs in these two cases. They were included to test for a possible set simply to give different responses to different questions (the other subtasks test for a set to do the opposite); it was also hoped that, together with the other differences among subtask displays, they would lend needed variety and flexibility to the Picture task sequence. In each subtask S could, of course, always look on E's side if he should forget what was displayed there, since he rather than E held the card; few Ss did so, however.

Eye Position task. -- Four toys were suspended or placed in various positions around S, who was seated in a chair: an airplane on the ceiling above and a little in front of his head; a boat and a truck on the walls to his right and left, respectively; and a block on the floor just in front of his feet. E sat facing S, at S's eye level and about 4 feet away. After pointing to each object in turn and asking S to name it, E said, "Now this time, instead of pointing to the toys with

my finger I'm going to look at them with my eyes and you tell me which one I'm looking at." As soon as she was sure S was watching, E closed her eyes, moved them to th appropriate orientation while still closed (thus, S never saw any eye movements or "visual gestures" in an object's direction), opened them again, and continued to stare fixedly at the object in question until S responded. Her eye fixations were randomly ordered, with a total of 2 for each of the 4 objects.

Task order was counterbalanced for the 2 year olds; through a regrettable but fortunately not very serious inadvertence (in view of their task performance), all 9 of the 3 year olds experienced them in the order Picture--Eye Position. Since some of the younger Ss had very limited language production (as distinguished from comprehension) skills, Ss were allowed to point to what E was looking at rather than name it; most referential responses turned out to be verbal nonetheless. Great care was taken to instruct and question each child only when E appeared to have his full attention.

Results and Discussion

All 25 Ss answered correctly on both of the two "control," non-inferential subtasks (2 and 4) of the Picture task. Eight of the 16 2 year olds and 8 of the 9 3 year olds also responded correctly on all four of the remaining, critical subtasks. Performance was roughly comparable on the Eye Position task. Six of the 16 2 year olds and 7 of the 9 3 year olds were correct on 6 or more of the 8 trials, a a satisfactorily conservative response criterion in view of the fact that each trial presented S with 4 objects from which to choose. No trend toward sex differences was discernable in either task. Table 1 shows the number of 2- and 3-year olds who satisfy these rigorous response criteria on neither, either one, or both of the two tasks. Chi

square tests revealed no significant age differences in performance on either task considered separately. The number of Ss who solved both tasks versus one or none did, however, increase with age: Yates-corrected $\chi^2(1) = 4.02$, $p < .05$.

Insert Table 1 about here

In a wholly independent investigation, Bigelow (1972) administered a slightly modified version of our Picture task to 4 Ss at each of ages 22, 25, 28, and 31 months, therefore averaging a few months younger than our 2 year old sample. Two Ss responded correctly on all of Bigelow's 4 critical subtasks and 2 others did so on 3 of the 4. Seven tended to go around to E's side to look (E rather than S held the card in Bigelow's procedure) and did not perform correctly if E prevented them from doing so; as indicated above, few of our Ss showed this response pattern. Eleven of the 16 Ss, therefore, seemed at least to be aware that E saw something different from what they themselves saw. The remaining 5 Ss always performed incorrectly, i.e., egocentrically, when asked to indicate what E saw; Bigelow was uncertain whether the youngest of these Ss (3 22 month olds) really understood the task, however. These results seem reasonably consistent with our own 2-year-old data on the Picture task. As will be shown in Experiment 2, the near-ceiling performance of our youngish 3 year olds on this task is also a replicable finding.

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So high a level of correct responding by children so young on anything resembling a perceptual role taking or percept inference task is quite surprising. Such results immediately raise two questions. First, does correct responding on these tests <u>really</u> imply a genuine understanding of the general fact that, like S himself, E is a being capable

of visual acts and percepts, and more specifically that, unlike S, E is currently looking at and seeing the object S has named? In other words, does such responding reflect genuine percept attribution and percept inference, or might it artifactually reflect some more primitive cognitive process? Second, if we could at least tentatively credit children of this age with some sort of ability to infer percepts in others, exactly what sort of ability might it be? Is it fundamentally the same as that demanded by tasks of the three-mountains genre, for instance, or is it something different?

With reference to the first question, it must be admitted that alternative cognitive mechanisms certainly cannot be ruled out. In the Picture task especially, it is possible that S may have construed the question, 'What do I see?", as the question, "What is on my side of the card?". The latter question obviously does not require any knowledge that other people possess those inner psychological processes we call visual percepts. Similarly (although less convincingly, perhaps), the child may have interpreted E's eye positions exactly as he did her manual pointing -- as indications only of what (object) is there, in that position, rather than as indications of what is currently being seen by another. While readily admitting the cogency of these alternative explanations, there is at least some informal evidence which strongly suggests that very young children may in fact know something about people's visual acts and percepts as well as about the purely physical whereabouts of objects. On subtask 4 of the Picture task (transparent center section with opaque surround), for example, one 2 year old said "Me" in response to E's second question -- an unlikely response had she been thinking only about subjectless object locations.

In addition, one of our colleagues has seen his 22 month old son hold a camera to his doll's eye after having looked through it himself, and another has observed his 22 month old daughter "showing" a picture book to her doll, saying "See -- apple," etc., while pushing the doll's face toward the picture on each page. Finally, author Flavell has recently obtained pilot data indicating that children of this age or younger can be surprisingly competent, when assessed under more naturalistic, informal conditions, at nonegocentric, O-oriented showing of pictures (somewhat similar to the Picture task), at accurate reading of O's direction of gaze from O's eye position (exactly equivalent to the Eye Position task), and at other behaviors seemingly requiring at least tacit inferences about O's visual acts and percepts. It may well be, of course, that children this young do not actually project themselves psychologically into O's spatial position, or actually imagine or represent his conscious perceptual experience. The Picture and Eye Position tasks could certainly be solved without such projectings and imaginings, and probably are at this age level.

Assuming, therefore, that very young children may be able to represent something concerning the visual percepts of others, what might that something be? It is possible (Flavell, 1973) that their knowledge of their own and other peoples' visual experiences is less differentiated than that required even to comprehend, let alone solve, a standard three-mountains type, perspective-taking problem. The young child does really understand that he and other people have visual imputs, according to this hypothesis. He also understands that another person may or may not see the same object that he sees, depending upon certain grossly characterizable situational variables, such as the

orientation of O's head and eyes with respect to the objects viewed. However, he may not yet fully understand the concept of perspective-on-a-given object. That is, he may not yet be attuned to the fact that O not only sees a certain object, versus not seeing it, but also that O sees a particular view or perspective of that object, versus seeing another view or perspective of it. Thus, the young child's cognitive representation of O's visual experiences may at first be all or none and "real object" centered, perhaps because it is objects as such rather than views of objects that have functional significance for him in his everyday life. Accordingly, he can represent the fact that O sees and can also, given strong cues, infer what (object) O sees. In contrast, he may not yet be disposed or able to represent how, in the perspectival sense, that object is seen by O.

According to this conception, then, there may be at least two distinguishable developmental levels of knowledge or understanding in this domain (Flavell, 1973). Level 1 understanding is the whole-object-centered form just described; a Level 1 child represents the that and the what, but not the how, of O's visual experience. Level 2 understanding also encompasses the perspectival how. A Level 2 child at least understands what is being asked of him in something like Piaget's three-mountains task, even though he may of course still be unable to "compute" O's exact visual perspective. In contrast, a Level 1 child does not really understand what is being asked of him; the available cues tell him that both he and O see "mountains," and that is as far as his processing of the information goes. Experiment 2 was an attempt to obtain empirical evidence for this Level 1-Level 2 distinction.

Experiment 2

Method

Subjects

The Ss were 60 children, 12 from within each half year interval between 3 and 5 1/2 years of age (mean ages = 3-2, 3-9, 4-1, 4-8, and 5-3 years); the distribution of boys and girls in each of these 5 age groups was approximately equal. The Ss, largely middle and upper-middle class in background, were obtained from a nursery school and a private day care center. An additional 10 children were dropped from the sample because they failed to complete one or more tasks.

Design

The 5 tasks used in this experiment are listed in Table 2. The Picture and Turtle tasks together form a pair and the Fishes and

Insert Table 2 about here

Witches tasks constitute a second pair, deliberately made to be different in stimulus and response characteristics from the first. The objective within each pair was to devise two measures of similar task structure and roughly equal information processing demands ("performance demands" in the psycholinguistic sense), one of which requires only Level 1 inference for its solution while the other requires Level 2 inference. This objective is analogous to Smedslund's (1964, pp. 26-27) strategy of trying to equate tasks for "percepts" and "goal objects" while varying "inference patterns." If there is any developmental-psychological reality to these hypothesized levels, the Level 2 member of each pair should prove to be the harder and later-mastered task of the two. It was accordingly predicted that Turtle (Level 2) should be

harder that Picture (Level 1), and Witches (Level 2) harder than Fishes (Level 1). The Clown task seemed ambiguous or uncertain with respect to developmental level, and was included in the battery out of sheer curiosity.

All 5 tasks were administered to each S. Ten questions were asked in each task, 4 requesting S to indicate his own percept and 6 to indicate E's. As will be explained, the 10 questions formed 3 groups of 4, 4, and 2. The order of tasks and of question groups within tasks was randomized for each S. In all tasks, S and E sat facing each other across a small table, with the test stimulus placed between them.

Task Materials and Procedures

All Ss were thoroughly familiarized with each tasks's materials and terminology before administration of that task began.

Picture task. -- This was a slightly modified version of the Picture task described in Experiment 1. The E held vertically between S and himself a 10 X 10-inch piece of cardboard with cut-out pictures of a dog pasted on one side and of a cat on the other. In one group of 4 questions, E first asked, "Do you see a dog (cat), or, do you see a cat (dog)?" After S's response, he then asked, "Do I (emphasized) see a dog, or, do I see a cat?" The card was then reversed and the same two questions repeated in the same order. The other group of 4 questions was identical except that E reversed the card immediately following the initial, S-percept question, so that E's percept now became identical to what S's had just been. In the third, 2-question group, E did not preface questions about his percept with questions about S's, i.e., only E-percept questions were asked. This same, 3-group question

format was used in all 5 tasks.

Turtle task. -- The E held horizontally between S and himself an 8 1/2 X 11-inch piece of cardboard with a side view, in-profile picture of a turtle mounted on it. The questions on this Level 2 task had to do with how the turtle was viewed by S and E rather than what object each saw, namely, "Do you (I) see the turtle rightside up (i.e., on his feet -- although these words were not used), or do you (I) see the turtle upside down (i.e., on his back)?" The operational definitions of the two critical expressions were of course made very clear to each S before testing began (some children preferred to use "upside up" as their contrast to "upside down," which seemed perfectly reasonable to us).

Fishes task. -- Six "Mr. Potato Fish" toys, manufactured by Hasbro Industries, Inc., served as stimuli in this task. Three of these brilliantly colored, potato-sized, "nonsense" fishes, each highly discriminable in appearance from the other two, faced outwards, at 120° angles from one another in the horizontal plane, from the ends of 5-inch wooden dowels, the dowels being attached like spokes to the top of a central, vertical wooden shaft 10 inches high. The shaft itself was mounted in a 7 X 3 1/2 X 1 1/2-inch wooden block and hence the whole display could be rotated to cause any fish to face any stationary observer. Three comparison fishes, each identical to one of the above, were lined up facing S to one side of the display. After S had matched each fish with its twin in the display, S and E were so positioned that a different display fish faced and was closest to each person. The critical question was, "Does the one that you (I) see best look like this one, this one, or this one (pointing to each comparison fish in

turn)?" In both pilot work and the present study, Ss took the one they "see best" to mean the one closest to and facing them, as we had intended they should.

Witches task. -- The stimuli were four identical "Squishies," soft, rubberized, fist-sized toy witch heads made by Mattel, Inc. Each presented a long, beak-like nose and gaping mouth in front view, and a peaked hat in rear view. The three comparison witches were grouped together in a line and so positioned that S viewed one of them full face, one back to, and one from the side. The test witch resided about 18 inches away and was always presented to S either front to or back to during the task proper (and hence, of course, back to or front to E). Prior to testing, S was asked to match each of three orientations of the test witch with the correspondingly oriented comparison witch from his own point of view, and if necessary, was coached until he could do so with no help from E. When testing began, a cardboard screen was placed between E and the three comparison witches so that E could not see them. (Pilot testing had revealed that some older children who proved able to solve the task when the screen was present would, if it were absent, misinterpret the E-perspective questions as requesting the identification of the comparison witch that looks to E himself like the test witch looks to E.) The questioning proceeded as follows: "Which one of these witches looks exactly like what you see (exactly like what I see)?" Then reaching over the screen and pointing to each comparison witch in turn but continuing to look only at the test witch, E said, "Is it this one, this one, or this one?" About all that can really be said in defense of this particular phrasing of the key question is that, in pilot work, older preschoolers seemed to respond to it somewhat more

successfully than to other variations we tried. Notice the intended similarities and differences between the Fishes and Witches tasks. In Fishes, different whole objects are seen ("best") from different vantage points around an object-bearing "vehicle," i.e., the block, shaft, and dowels. In Witches, different views of a single whole object are seen from different vantage points around that object itself.

Clown. The stimulus was an 8 X 10-inch card showing a line drawing of a clown's face. Viewed from one orientation, a smiling face is seen. If the picture is rotated 180° from that orientation, one sees a frowning face instead. The testing procedure was identical to that of the Turtle task, except that the questions were, "Do you (I) see the smiling face, or do you (I) see the frowning face?" This is a Level 2-like task in that S and E have different views of a common physical stimulus. It is a Level 1-like task, on the other hand, in that each view gives rise to the perception of a different whole object (face), rather than a different perspective on the same object. We were accordingly curious to find out whether its difficulty level would more closely match that of the Picture task or that of the Turtle task.

Results and Discussion

Of the 10 questions asked in each task, 4 referred to S's own view and were therefore not included in the data analyses reported below (as might be predicted, even the youngest Ss always answered these questions correctly). Simple inspection of responses to the 6 E-view questions showed that the following variables were clearly not significantly associated with differential responding on any task: (1) question format, as described above under Picture task (2) serial position of a question within the questioning sequence of a given task (3) sex of S.

It was accordingly decided to combine sexes within each age group and to sum correct E-view responses within each task. Table 3 contains the task X age group means of these summed scores, together with the numbers of Ss achieving scores of either 5 or 6. These and related data will first be described informally with the supporting statistics

Insert Table 3 about here

provided afterwards.

It is apparent that both of the predicted differences in difficulty level/age of mastery were obtained in this study. Consistent with the results of Experiment 1, the Picture task proved to be extremely easy for even the youngest Ss tested. In contrast, mean level of responding to the Turtle task was about at chance in the 3-4 year old groups, rising abruptly to near-ceiling at 4-4 1/2 years. Similarly, the Fishes task was almost as easy as the Picture task, except perhaps for the 3-3 1/2 year olds. In contrast again, Witches was clearly the hardest task in the battery, with mean performance continuing to improve from the second oldest to the oldest group. The developmental curve for the Clown task turned out to be roughly congruent with that of the Turtle task rather than that of the Picture task. If "age of mastery" were to be arbitrarily defined as the age at which at least 2/3 of the Ss first reach the 5-correct-response performance criterion, then Turtle is mastered at least 1 year later than Picture (and at the same age as Clown) and Witches is mastered at least 2 years later than Fishes.

There were also some minor findings of interest. The side-view comparison witch was virtually never selected (only 5 trials out of a possible 360), and thus practically all incorrect responses on the Witches task were egocentric, S-view ones. Correlations between tasks

within age groups were computed in those few instances where ceiling or floor effects would not have made such computations meaningless; the only one that proved significant was between Turtle and Clown at age 3-3 1/2 years (r = .78, $p < .01$). The only going-around-to-look behavior observed in Experiment 2 was produced by 4 3-3 1/2 year olds on the Witches task. One of them went around to E's position on all 6 trials, and he proved to be the sole S who achieved criterion in that age group (see Table 3). The other 3 went around only once or twice and proceeded to respond egocentrically when they returned to their own position.

As to statistical documentation for the principal findings, an age X task analysis of variance yielded significant main effects for age, F (4,55) = 20.44, $p < .001$, and for task, F (4,220) = 50.61, $p < .001$, and also a significant age X task interaction, F (16,220) = 5.54, $p < .01$. Neuman-Keuls comparisons revealed the following significant differences in task difficulty within age groups. Witches was harder than all other tasks for each of the four youngest groups. Turtle and Clown were each harder than both Picture and Fishes in each of the two youngest groups. All of the above-mentioned differences were significant at $p < .01$, save for the Witches-Clown comparison at 3-3 1/2 years ($p < .05$).

The results for the two critical comparisons, Picture-Turtle and Fishes-Witches, lend some empirical support to the proposed developmental distinction between Level 1 and Level 2 type percept inference. There remain two problems, however. First, we frankly doubt if the Fishes-Witches pair provided as methodologically clean a test of the hypothesis as did the Picture-Turtle comparison. On the one hand, Fishes was not the exact three-dimensional counterpart of Picture,

inasmuch as all three objects were in fact visible from both S and E positions and we had therefore to resort to a rather peculiar "see best" instruction. More seriously, a number of potential Level 2 thinkers may for various reasons have misinterpreted the Witches instruction as calling for a simple perceptual match, from S's own viewing position, between the test witch and one of the comparison witches. Alternatively, the temptation to match (doubtless an easy, prepotent response here) may have overridden any initial momentarily correct interpretation of the instructions. The overwhelming preponderance of egocentric, S view type incorrect responses obtained would be consistent with either possibility. It might, in retrospect, have been possible to devise a psychologically easier, and psychometrically less "noisy" task involving three-dimensional stimuli which would still appear to demand Level 2 inference (see Experiment 3). The fact that the 5-5 1/2 year olds did as well as they did on Witches may attest to the solidity of their basic Level 2 competence.

The obtained difference in difficulty between Picture and Turtle seems to be a more convincing result, but it has led us to wonder if our Level 1-Level 2 distinction may not need further specification and explication in information-processing terms before it can be taken seriously as a possible explanation for such a finding. Why, exactly, do 3 year olds find Picture easy and Turtle hard (and, task design problems aside, Fishes easy and Witches hard)? The answer might be that an extra, spontaneously produced recoding operation is needed to solve Turtle and Witches. Suppose we reconstrue the Picture card, the Fishes apparatus, the turtle and the witch as all being "whole objects" which possess different sides and bear different parts or "subobjects"

on these sides. Thus, there is a cat on one side of the Picture card, a particular fish on one side of the Fishes apparatus, a nose (peaked hat, etc.) on one side of the witch, and a shell (legs, etc.) on one side of the turtle. Let us assume that the Level 1 child does understand the basic fact that another person normally sees ("sees best," etc.) those objects (whole objects, object parts, or subobjects) that are perceived or known by the child to lie roughly along the person's line of regard, in the center of his visual field. In Picture and Fishes, the child is explicitly asked to designate, from among several choices, the object that meets this line-of-sight condition for person E, and he easily does so. In Turtle and Witches, on the other hand, he is not asked to designate any such object, but rather to indicate how, the manner in which, a particular whole object is seen or appears. While such "how" questions can of course be reinterpreted as questions about what objects are seen or "seen best" from a given position, they are not explicitly "what" questions. In asking whether E sees the turtle "rightside up," for instance, E is only implicitly asking whether he sees the feet or the shell "best" (closest to him) from where he is sitting. Similarly, E is only implicitly asking whether he sees or "sees best" the witch's nose, eyes, etc. versus her back, hat peak, etc. when viewing her from a certain vantage point. In both cases, it is left to the child himself to pick up the concrete, object-perception implications of E's stated question, and thence to use his Level 1 knowledge to answer it. The major purpose of Experiment 3 was to see what would happen to the young child's performance when these implications were made explicit, i.e., when a Level 2 task was presented in an essentially Level 1 fashion.

Experiment 3

Method

Subjects

The Ss were 6 boys and 6 girls very similar in age (mean = 3-9 years) and background to the 3 1/2-4 year old group in Experiment 2.

Design

Four tasks were administered to all Ss in the order Witch-spots, Witch-split (for half the Ss, the other half receiving these two tasks in the opposite order), Witches, and Block. The first two tasks were Level 1 versions of Witches. We were interested to see if 3 1/2-4 year olds would perform well on these tasks, and if they did, whether there would then be positive transfer to a "near" Level 2 task (Witches) and a "far" Level 2 task (Block). The Block test was also included because it appeared to be a better, less "noisy" three-dimensional Level 2 task than Witches.

Task Materials and Procedures

Witch-spots. For added perceptual salience of the critical sub-objects, a blue spot was painted on the nose of one of the toy witches and an orange spot painted on the peak of her hat. This single witch was placed on the table between S and E, always in front or back view to each observer, and the questions were: "Do you (I) see the nose with the blue spot or do you (I) see the hat with the orange spot?" In this and the other three tasks, 6 E-view and 4 S-view responses were obtained exactly as in Experiment 2.

Witch-split. Another witch was split laterally down the middle and the front and back halves mounted on opposite sides of a board, thus producing a kind of bas-relief analogue of the Picture task. Task administration was identical to that of Witch-spots, except that the

questions were: "Do you (I) see the witche's nose or the witch's hat?"

Witches. -- As in Experiment 2.

Block. -- A 13 X 10-inch wooden board was supported on each of its narrow ends by a vertical board 10 inches long and 6 1/2 inches high, thus making a raised platform. A 6 X 3 1/2 X 1 1/2-inch block was nailed in vertical position to the center of this platform, with its longer (3 1/2-inch) side parallel to the long (13-inch) axis of the platform. This display was photographed in black and white as it would appear to a child looking at it from the front and from the side; the object images in the two photographs were 1/3 the size of their referents in the display. After the child had first demonstrated that he could match either view of the display with its corresponding photograph (an easy task for all Ss), E sat to S's left so that he saw the display in side view whenever S saw it in front view and vice versa. The two photographs were placed side by side directly in front of S, and E asked: "Which one looks like what you (I) see? Is it this one, or this one (pointing to photographs)?"

Results and Discussion

As in Experiment 2, all S-view questions were correctly answered, and there were no apparent effects of question format, question serial position, or sex of S on E-view responding. No S went around to E's position to look in any of the 4 tasks. Table 4 presents all the data of interest. Three things are apparent: (1) the two modified Witch

Insert Table 4 about here

tasks are just as easy for 3 1/2-4 year olds as their Picture and Fishes counterparts; (2) the Ss learned nothing from their experience with these tasks that transferred positively to the original Witches

problem, nothing that helped them "catch on" to what that problem implicitly demanded in the way of subobject analysis; and (3), assuming no positive or negative transfer effects from the preceding 3 tasks, Block is just about as hard for 3 1/2-4 year olds as Turtle and Clown.

These results are at least consistent with the analysis presented at the end of Experiment 2, although they of course do not rule out other interpretations of what is developing in this domain. They are also consistent with some data obtained by Fishbein, Lewis, and Keiffer (1972). In one of their tasks, reminiscent of Witch-spots and Witch-split, Ss were asked to turn a tray containing meaningful objects so that verbally specified objects and (sometimes) associated subobjects were visible to E, e.g., "Show me the front of the mouse and the side of the soldier holding his candy cane" (the soldier is saluting with his other hand). The youngest Ss tested in this fashion were 3 1/2 years of age, and they performed almost errorlessly. Two other tasks were more similar to Block, in that photographs of the objects were used, and to Block, Turtle, Clown, and Witches in that no verbal specification of object sides or parts was ever made. In these tasks, Ss had either to turn the object-bearing tray "so that I can see this picture" (pointing to a specific photograph) or, with no turning involved, to "point to the picture which looks like what I can see from where I am sitting." Performance was considerably poorer under these instructions, a contrast that becomes more dramatic when one realizes that corrective feedback was given on each trial in all the Fishbein et al. tasks. Their Ss did not seem to need such feedback in the first-mentioned, Level 1-like task, and did not seem to profit much from it in the latter two, Level 2-like tasks. Fishbein et al. likewise

suggest that explicitly calling attention to precisely what E is supposed to see may have been partly responsible for the lesser difficulty of their first task (1972, p. 27).

Conclusions

Some conclusions may be tentatively drawn from the results of these three experiments. First, some degree of skill in inferring the object or target of another's looking-seeing activity appears to have been acquired by 2-3 years of age, and quite possibly earlier. Second, the skill in question may be more limited, more object- versus view-oriented, than that required to solve traditional perspective-taking tasks, such as Piaget's three mountains problem and any simpler, one-object analogue of that problem. This initial, more limited ability was referred to as Level 1 percept inference, in contrast to later-developing Level 2 percept inference, the hypothesized basic prerequisite for traditional perspective-taking tasks. It is possible, but not certain on present evidence, that at least part of the younger child's difficulty is that he does not spontaneously translate a global request to identify O's view of something into an invitation to identify the specific side, parts, or "subobjects" of that something which O's eye position suggests that O currently sees, or sees "best" (e.g., closest to him, most clearly or completely). When explicitly asked to make such specific identifications, on the other hand, he appears under some task circumstances to be quite capable of doing so, as the description of Level 1 ability would lead one to predict.

Several important questions can only be answered by additional, more analytical research on the early development of visual percept inference. First, is the above a correct description of at least one

difference between younger and older children's cognitive processing of visual-perspective problems? Second, are there additional developmental differences in information processing here which also contribute to differential performance on "easy" Level 2 problems, i.e., apart from the complex spatial-representational abilities that must figure in all "hard" Level 2 problems, such as the three-mountains one? For example, older children may make some mental effort to imagine themselves in O's position and to visualize what he sees, whereas younger children may never even try to do this. Is the above a correct description, then, and if correct, is it also a complete description? Finally, how much of what kinds of training or experience is needed to effect the developmental transition from Level 1 to Level 2, or less interpretively put, from an information-processing system that can easily solve Picture, Fishes, Witch-spots, and Witch-split to one that can easily solve Turtle, Witches, Clown, and Block?

References

Bigelow, A. The child's ability to take another's point of view and his ability to use first and second person pronouns: A study in the correspondence between thought and language. Unpublished study, Simon Fraser University, 1972.

Borke, H. Interpersonal perception of young children: egocentrism or empathy? Developmental Psychology, 1971, 5, 263-269.

Fishbein, H. D., Lewis, S., & Keiffer, K. Children's understanding of spatial relations: coordination of perspectives. Developmental Psychology, 1972, 7, 21-33.

Flavell, J. H. The development of inferences about others. In T. Mischel (Ed.), Understanding other persons. Oxford, England: Blackwell, Basil, and Mott, 1973. Pp. 66-116.

Flavell, J. H., Botkin, P. T., Fry, C. L, Wright, J. W.,& Jarvis, P. E. The development of role-taking and communication skills in children. New York: Wiley, 1968.

Laubengayer, M. C. The effects of training on the spatial egocentrism of preschoolers. Unpublished master's thesis, University of Minnesota, 1965.

Laurendeau, M., & Pinard, A. Development of the concept of space in the child. New York: International Universities Press, 1970.

Lewis, S., & Fishbein, H. D. Space perception in children: a disconfirmation of Piaget's developmental hypothesis. Paper presented at Psychonomic Society Meetings, St. Louis, November, 1969.

Marvin, R. S. Attachment and communicative-behavior in two, three, and four year old children. Unpublished doctoral dissertation, University of Chicago, 1971.

Piaget, J., & Inhelder, B. The child's conception of space. London: Routledge & Kegan Paul, 1956.

Shantz, C. U., & Watson, J. S. Assessment of spatial egocentrism through expectancy violation. Psychonomic Science, 1970, 18(2), 93-94.

Footnotes

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[1]These same Ss were also given a test of the child's ability to make appropriate attributions or inferences of "happy" versus "sad" feelings to both self and E, each person symbolized by a doll, as a function of how each doll was treated by the other (i.e., positively or negatively). To illustrate, the S doll is made to hug (kiss, kick, push, etc.) the E doll and the child is to indicate whether he thinks this makes the E doll "happy" or "sad." Most of the 2 year olds did very poorly on this task (inadequate verbal skills may have been partly responsible here), but the 3 year olds performed just about as close to ceiling as they did on the two percept-inference tasks. These facts are mentioned in a footnote partly because inference about visual percepts rather than about affects was the primary research target in Experiment 1, but mostly because a larger-scale developmental investigation by Borke (1971), published just after we had completed data collection, makes a more detailed report of our work unnecessary. She tested 25 3-3.5 year olds (the youngest of her 8 age groups) using procedures similar to ours and reached similar conclusions: ". . . it is

suggested by the data that children as young as 3 years of age are aware that other people have feelings and that these feelings vary according to the situation in which the individual finds himself" (Borke, 1971, p. 269).

Table 1

Number of Ss at Each Age Level Achieving Criterion on 0, 1, and 2 Tasks

Age	Tasks Passed		
Group	0	1	2
2-3	6	6	4
3-3 1/2	1	1	7

Table 2

Tasks Used in Experiment 2

Task	Task Characteristics		
	Level	Stimulus	Response
Picture	1	picture	verbal, 2-choice
Turtle	2	picture	verbal, 2-choice
Fishes	1	object	nonverbal, 3-choice
Witches	2	object	nonverbal, 3-choice
Clown	uncertain	picture	verbal, 2-choice

Table 3

Mean Number of Correct Responses

by Task and Age Group

Task	Age Group				
	3-3 1/2	3 1/2-4	4-4 1/2	4 1/2-5	5-5 1/2
Picture	6.00(12)[a]	6.00(12)	6.00(12)	6.00(12)	6.00(12)
Turtle	2.50(3)	3.83(6)	5.75(11)	6.00(12)	5.50(12)
Fishes	5.00(8)	5.75(12)	5.92(12)	6.00(12)	6.00(12)
Witches	1.17(1)	1.67(1)	3.17(4)	4.00(7)	5.42(10)
Clown	3.17(6)	3.17(5)	5.83(12)	6.00(12)	5.92(12)

[a]Numbers in parentheses refer to the number of Ss making at least 5 out of 6 correct responses (N = 12 per age group).

Table 4

Mean Number of Correct Responses by Task

Age	Task			
Group	Witch-split	Witch-spots	Witches	Block
3 1/2-4	5.92(12)[a]	5.92(12)	0.67(0)	3.08(3)

[a]Numbers in parentheses refer to the number of Ss making at least 5 out of 6 correct responses (N = 12).